

Mango

Robert E. Paull and Ching Cheng Chen
Department of Tropical Plant and Soil Sciences
University of Hawaii at Manoa, Honolulu, HI

Scientific Name and Introduction: Mango (*Mangifera indica* L.) is cultivated throughout the tropics and warmer sub-tropics. There are numerous varieties, with the Florida varieties Tommy Atkins, Kent, Keitt, and Haden being the most common in the U.S. Fruit skin is yellow or green with a golden to red blush. Weight can vary from 200 g to 1 kg (0.5 to 1 lb) and can be round, oval or kidney shaped. Some varieties have a turpentine like smell and taste.

Quality Characteristics and Criteria: Skin coloration, size, shape for variety, appearance, freedom from defects and decay, absence of fiber in the flesh and a turpentine-like flavors are the most common quality parameters. Wilted, grayish discoloration and pitting are undesirable. Some fruit varieties (Haden) have pinhead-size black spotting that is not regarded as a defect.

Horticultural Maturity Indices: The general measures of maturity for most cultivars of mango are when the fruit “shoulders” have risen above the stem-end and there is a slight skin color break on the first fruit of a crop. Early fruit from a single flowering should only be harvested after a slight skin color change, 2 weeks later all full-size fruit can be harvested, even if there is no apparent skin color change. Other indices include, SSC and TA, fruit specific gravity and days from blooming. These indices need to be adjusted for cultivar and season (Hatton et al., 1965; Kanes et al., 1982).

Grades, Sizes and Packaging: There are no U.S. or International Grade standards. Color is green-yellow to red blush, depending upon variety. Fruit are sold in 16 kg (35 lb) cartons as well as 6 kg (14 lb) flat single-layer cartons, and 4.5 kg (10 lb) single-piece fiberboard boxes with various counts.

Pre-cooling Conditions: Fruit are normally forced-air or room-cooled, preferably within 24 h of harvest (Mattern et al., 1972).

Optimum Storage Conditions: Storage at 10 to 13 °C (50 to 55 °F) with 85 to 90% RH, should give a shelf-life of 14 to 28 days for mature green fruit, depending upon variety. Ripe fruit can be stored at 7 to 8 °C (44.6 to 46.4 °F). Diseases are the principal factor limiting storage-life. Optimum ripening temperature is 20 to 23 °C (68.0 to 73.4 °F) for best appearance, palatability and decay control (Jobin-Decor, 1988).

Controlled Atmospheres (CA) Considerations: Different cultivars show various responses to CA. The optimum storage atmospheres for prolonging storage and/or shipping are 3 to 5% O₂ + 5 to 10% CO₂ at 7 to 9 °C (44.6 to 48.2 °F) with 90% RH (Yahia, 1998). Ripening delays are minor and may not be economic in all situations. Polyethylene or other film bags with and without an ethylene absorber give some delay in ripening. However, some bags lead to off-flavor and abnormal skin coloration.

Retail Outlet Display Considerations: Display at store temperature, do not mist. Discard bruised and diseased fruit from display.

Chilling Sensitivity: Chilling susceptibility varies with cultivar; Haden and Keitt are particularly susceptible. Most cultivars show injury below 10 °C (50 °F), especially if fruit have just reached maturity. Tolerance to chilling increases during ripening (Medlicott et al., 1990). The symptoms include

grayish, scald-like discoloration on the skin, followed by pitting, uneven ripening, and poor flavor and color development (Hatton et al., 1965; Medlicott et al., 1990). Heat treatment prior to storage reduces injury in 'Keitt' (McCollum et al., 1993).

Ethylene Production and Sensitivity: Mangoes have moderate ethylene production of 1 to 2 $\mu\text{L kg}^{-1} \text{h}^{-1}$ at 20 °C (68 °F). Ethylene induces faster and more uniform softening (Lakshminarayana, 1973; Barmore, 1974). Ethylene treatment can be done prior to shipping (Barmore and Mitchell, 1977). There is disagreement in the literature regarding effect of ethylene treatment on quality (Chaplin, 1988). This may relate to maturity when treated. Treatment of immature fruit leads to softening, but the fruit have poor flavor.

Respiration Rate:

Temperature	$\text{mg CO}_2 \text{ kg}^{-1} \text{h}^{-1}$
4.5 °C	10 to 22
10 °C	23 to 46
15 °C	45 to 90
20 °C	75 to 151

To get $\text{mL kg}^{-1} \text{h}^{-1}$, divide the $\text{mg kg}^{-1} \text{h}^{-1}$ rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply $\text{mg kg}^{-1} \text{h}^{-1}$ by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day. Data are from Karmarkar and Joshi (1941) and Lam (1987).

Heating for insect disinfestation elevates respiration 3- to 5-fold; after cooling, rates remain higher than those of unheated fruit for 4 to 6 days (Mitcham and McDonald, 1993).

Physiological Disorders: Some disorders, such as chilling injury and high CO_2 injury, are induced after harvest, while others are inherent. Inherent disorders occur intermittently, and are unpredictable, such as jelly seed, which results in watery, translucent tissue around the seed giving an over-ripe appearance. It does not develop after harvest unless it was present at harvest (Young and Miner, 1961). Some cultivars are very susceptible, such as Tommy Atkins (Lelyveld and Smith, 1979). Soft nose and internal breakdown (or spongy tissue) are other disorders (Lim and Khoo, 1985), though it is possible these are one in the same. Sap burn is a major problem with some cultivars (O'Hare, 1994), such as Kensington, while Irwin is less susceptible (Loney et al., 1992), water/detergent washing helps to avoid damage (Brown et al., 1986).

Postharvest Pathology: Anthracnose (*Colletotrichum gloesporioides*), that is due to pre-harvest infection and does not spread postharvest, and the postharvest stem end rots caused by several fungi that infect before and after harvest (often as wound invaders that spread postharvest), are the two most common diseases (Johnson and Coates, 1993). Anthracnose appears as fruit ripen and first appear as superficial black spots and streaks that then become sunken (Fitzell and Peak, 1984).

Alternaria rot (*Alternaria alternata*), a pre-harvest infection, can sometimes be a problem, while the postharvest wound infections can occasionally be severe such as Black Mold (*Aspergillus* spp.) and transit rot (*Rhizopus* spp). Disease control begins in the field followed by postharvest sanitation, avoidance of latex burn (stain) and mechanical injury. Hot water treatment 46 °C for 60 to 120 min and fungicides can be used, depending on cultivar (Spalding and Reeder, 1986). Hot water brushing at 55 °C (131 °F) for 20 s shows good control (Prusky et al., 1999).

Quarantine Issues: As a fruit fly host, mango must be treated prior to import into the U.S. Hot water at 46.5 °C (116 °F) for 65 to 90 min, vapor heat with fruit core temperature of 46 to 48 °C (115 to 118 °F), and irradiation (300 Grays) are potential treatments.

Suitability as Fresh-cut Product: Fresh-cut pieces and slices are frequently found in markets. Flesh browning can be a problem in some cases.

Special Considerations: None

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